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ANTHROPOLOGY'S CONTRIBUTION TO INTERRACIAL UNDERSTANDING[1]

By Dr. HARRY L. SHAPIRO
AMERICAN MUSEUM OF NATURAL HISTORY

THERE still exists in our industrial societies a tendency, inherited from the past, to regard technological progress as wholly beneficent. We have become accustomed to hail enthusiastically every advance for its own sake or for the greater ease it brings into our personal lives, without consideration for its effect upon our society. We have grasped eagerly at the fruits of science regardless of their price. Now we are discovering that they have a price; that every advance of technology enhances our responsibilities whether we like it or not. The radio, the movie, the airplane have, or should have, taught us that technology may be beneficent, but may also serve evil purposes; that the acceptance of these productions can not remain superficial but must enter into and profoundly alter the organization of our societies.

[1] Address delivered at the Cranbrook Institute of Science on the opening of an exhibit on the races of man, January 21, 1944.

In no aspect of our lives as members of a complex industrial community, or as a nation in the modern world, has technology brought greater responsibilities than in our attitudes toward the various groups that make up our society, or toward the peoples that constitute mankind. It is a commonly observed truism that the world grows more interdependent, and that our society demands increased cooperation from all its members, as mechanization progresses. As for the future that lies ahead who can question that this process with its demands will continue? There is, therefore, every reason to believe that more cooperation rather than less will be required of us, if the structure of our society is to be preserved. Indeed, the very war in which we are now engaged may be said to be the result of an effort to substitute coercion, intolerance and slavery for our traditional ideals of cooperation.

The evidences of intolerance and of lack of cooperation which confront us on all sides represent maladjustments which become increasingly portentous as the needs for tolerance and cooperation become more pressing. There can, I think, be no question that one of the gravest problems facing our internal as well as our external existence lies in our ability to compose the differences that exist and to create understanding in their place. This is particularly true of the United States, where, unfortunately, the materials for group antagonisms are all too abundant. Although essentially the United States has received its population, as have all other nations, by the immigration of various people, for no national populations are autochthonous, nevertheless the manner and circumstances of these settlements have been significant. Where England, Germany, France, Spain and other nations in prehistoric times or during ages of barbarism have been invaded, overrun or settled by the successive groups which now constitute their present population, the United States was settled in the full blaze of introspective history. Where European nations have taken millennia in the amalgamation and assimilation of their people, we have compressed the greatest migration in the history of man into three centuries. Where they have received neighboring people of similar culture or race, we have engulfed a native Indian people with representatives of every European people and forcibly inducted millions of African Negroes not to mention our acquisition of contingents from Asia.

Now, these circumstances of history and accident are pregnant with meaning for our future. Let us examine the consequences of these facts. It is, I think, a consideration of immense importance that this country was settled when it was, in a period of developed literacy and self-consciousness. Under such conditions, group identities and group traditions become quickly established and resist the solvents of time and association. The Pilgrim fathers and the Puritans, sharply aware of their peculiar status, intensified and immortalized it in their written records. The tradition thus created served to set apart its inheritors from all later comers unless they could by some means identify themselves with it. Similarly, the pioneer groups in the west lost no time in establishing their own legends and traditions which drew together in a common bond their descendants but shut out the settlers who followed them. Thus, there has grown up a system of hierarchies, local and national, which excludes whole sections of the population and erects barriers to assimilation and participation. In Europe where migration succeeded migration, priority of settlement confers no prestige. Indeed, if time is a factor at all, it is likely to be the latest conquerors coming in during historic and literate times who have a special exclusive tradition.

The rapidity of the settlement of the United States has also contributed to the fissures of our society. During the seventeenth and eighteenth centuries when immigration was relatively slow it was possible for newcomers arriving in small lots to become absorbed rather quickly, despite initial prejudices against them. But with the advent of the Irish and German waves of migration in the mid-nineteenth century, overwhelming numbers and differences in religion and culture created in the settled Americans an antagonism toward these newer immigrants which continued for a long time. With each succeeding wave and with the ever-increasing numbers, the fears and antagonisms were intensified. These we have inherited and will plague us in the future. Had these migrations consisted of Europeans only, we might look to their eventual absorption by the body of older Americans in the course of time, since the physical disparities are slight, the cultural ones disappear and only religious prejudices offer any obstacles. The injection, however, of large masses of Negroes and other non-European people into the population has created a profound schism. For these people bear with them the mark of their difference which neither cultural nor religious assimilation can efface. Thus, the welding of the American population into a harmonious community faces many difficulties whose final resolution requires tolerance and understanding. Without these essential attitudes we can expect aggravations of critical situations and serious dangers to our society.

When we look to the world beyond our borders we see there, too, the same forces of intolerance at work poisoning mutual understanding and respect, at a time when the technology of the future is likely to increase rather than to diminish the needs for international and inter-racial harmony. It is obvious, I think, that the task of building attitudes of tolerance, of fostering cooperation and of encouraging understanding in these matters is a long and tedious path. It is not a subject for evangelization. Not by an act of faith will the unregenerate become converted to the ways of tolerance. Only by the road of education and by the use of reason can we hope to create a lasting atmosphere of tolerance and cooperation.

In this effort we can, I believe, use with profit the lessons of anthropology, for it is the peculiar advantage of this discipline that it permits us to see mankind as a whole and to scrutinize ourselves with some degree of objectivity. All of us are born into a special group of circumstances and are molded and conditioned by them. Our views and our behavior are

regulated by them. We take ready-made our judgments and tend to react emotionally to any divergence from or interference with them. In a sense we are imprisoned in our own culture. Many of us never succeed in shaking off the shackles of our restricted horizons. But those who have been educated by experience or by learning to a broader view may escape the micro-culture of the specific group with which they are identified and achieve a larger perspective. I am sure that some of you may recall vividly the experience of an expanding world as you left behind the limitations of youth for the understanding and freedom of maturity. This is an experience which has its counterpart in the intellectual understanding of ourselves and of our culture which anthropology is able to impart. For anthropology deliberately undertakes to study man as a biological phenomenon like any other organism, and on its social side it seeks to lift the student out of his culture by treating it as one in many social experiments. Professor Boas once observed that his preoccupation with Eskimo culture permitted him to see his own with a fresh eye. Moreover, in placing man's struggle toward civilization in this perspective the anthropologist achieves a historical view which serves to correct the astigmatisms of the present.

In studying man in this fashion, anthropology teaches us among other things that civilization has never been the exclusive possession of one people and that the particular culture of any race or group of men is never the complete product of that race or group. Our own culture, stemming from western Europe, has roots in most of the civilizations of the past and has not hesitated to borrow from its living contemporaries. Our writing, for example, has come to us from Asia Minor via the Greeks; we have inherited principles of architecture discovered for us in Egypt, in the valleys of the Tigris-Euphrates and of the Indus; our knowledge of weaving probably originated in the Nile Valley, the use of cotton in India and silk in China. Egypt and Mesopotamia debate the honor of inventing agriculture and domesticating certain animals. From the American Indian we have received a variety of things such as food plants, snowshoes, the hammock and the adobe house; from the American Negro a rich source of music. The list of our borrowings and inheritances is long. Without them we could not have built our own civilization. Yet our debts have not made us humble. We behave as if we had created our civilization single-handed and had occupied a position of leadership from the beginning of civilization itself. Actually, we are not only the inheritors of a varied and complex tradition, but the present protagonists of western civilization are merely the latest of mankind to become civilized. One might add that they unfortunately show it. All during the prehistoric ages northwestern Europe represented a back water. Into these remote regions came the stone age innovations after they had been invented elsewhere. Similarly, the neolithic techniques and the use of bronze and iron only slowly were diffused to western Europe centuries after their discovery in Egypt and Mesopotamia. So wild and barbarous were the regions inhabited by the ancient Britons, the Scandinavians and the Germans that the Greeks never even knew of their existence. And to the Romans the inhabitants of these far distant corners were uncouth barbarians unfamiliar with the amenities of civilization. In fact, up to the time of the Renaissance the northwestern Europeans could hardly claim parity by any objective standard with a civilization such as the Chinese of the same epoch, or the native civilizations of Mexico or Peru where substantial achievements in social organization, architecture and art far surpassed contemporary European productions. Well into the Christian era the archeological remains of British culture display a crudity, quite unprophetic of their future evolution. If, then, we justly attribute this backwardness of northwestern Europe in the ways of civilization to the accidents of place and history, how can we fail to admit the potentialities of our contemporaries who give evidence by their learning, by their arts or by their skills of accomplishments fully as great as those of the ancient Briton, Gaul or German.

Though we admit the superiority of western civilization in technology and science, anthropology is decisive in disclaiming any equivalent supremacy in the social organization of the nations of the western world. Indeed, it would be easy to enumerate examples among non-European people with more complicated social systems or with more efficient ones. If it is true that the magnitude of our commerce and industry, enlarged by the resources of science, has created a stupendous economic structure upon our society, it is also true that the social framework which supports it is in certain respects inadequate and inefficient. We who are so proud of our gadgets, who misjudge those who live on a simpler material plane, who scorn others for their superstitions, how are we to judge our ancestors of two or three centuries ago who lacked all that we prize in the way of material comforts and who believed in witchcraft? One can not help but feel that our attitudes are something like those of the little boy whose superior Christmas present elevates him above his less fortunate mates.

One of the most pernicious breeders of ill-will among various races of mankind is the doctrine that

a racial hierarchy exists based upon physical and psychological superiorities. It is interesting that the preferred positions in this scale are reserved for the race to which the claimants think they belong. Notions of superiority are, of course, widespread. They permeate groups of all kinds and sizes. The city slicker's airs of superiority over his country cousin are tinged with the same smugness that characterizes rival parishes or sets off the Scotch Highlander from the Lowlanders, distinguishes the Englishman from the British colonial, the Nordic from the Mediterranean, the white races from the colored. They are all based on the idea that differences are degrees of goodness, whereas in most instances differences are merely reflections of environmental adaptations, historical accidents, local developments or simply superficial physical mutations of no intrinsic value. During the nineteenth century these ideas crystallized around the concept of race largely through the writing of de Gobineau, who extolled purity of race and in particular the virtues of the Nordic. This was a period when many so-called European races had each their protagonists. The Mediterranean man was hailed as the culture hero of Europe. English writers drew racial distinctions among their own peoples but spoke instead of Kelt or Saxon or Norman and attributed to them exclusive virtues or vices. The attributions were so precise that it must have been a rash Saxon who would presume to write mystic poetry or a foolhardy Kelt who would aspire to martial glory.

Race, which started out as a zoological concept, a convenient method of classifying mankind according to physical criteria, much as the kinds of animals might be distinguished, thus became encrusted with psychological attributes and assignments of value. We all know how this monstrous doctrine has been elevated into a credo, how it has been used to inflame and manipulate masses of men, how insidiously it is calculated to make even those who attack it disseminate its seeds. Anthropology, which traditionally has been concerned with the problems of race, has here, too, much to offer in clarifying and correcting racial misconceptions fostered for evil purposes. Perhaps I might best summarize this in a series of principles.

(1) The racial classification of man is primarily a zoological concept. It attempts merely to classify and distinguish the varieties of men by physical criteria.

(2) Migration and intermingling has from his earliest history been characteristic of man so that "pure" races, if they ever existed, are no longer to be found in nature.

(3) The consequence of this intermixture has led to the overlapping of physical characteristics between neighboring people with a pronounced tendency for changes in any physical characteristic to be gradual so that it is practically impossible to set arbitrary lines of division between one type and another.

(4) The geographic extremes of these continuities do show pronounced differences in physical criteria, such as the northwest European, the Chinese and the Negro of Central Africa.

(5) No nation is exclusively of one race, or breed. In Europe especially prehistoric and historic migrations have mixed the various European strains inextricably. There is for example no Nordic Germany. So-called Nordic tribes settled in France, invaded Italy, overran Spain and even reached North Africa. Each nation in Europe represents a composite varying somewhat in their ingredients and proportions.

(6) The psychological attributues of race are non-zoological and logically have no place in racial classification. They are not coterminous with race, which itself is an abstraction.

(7) Moreover, since psychological attributes are commonly based on subjective judgments, are resistant to precise measurement, and are often profoundly influenced by environmental and cultural conditions, they are not suitable as criteria in the classification of races. Their use has led to tragic distortions of truth.

Parenthetically, I can not forbear pointing out the illusions we cherish in the name of practicality. The charge used to be leveled against anthropology that it was not practical, that it was remote from the important concerns of everyday living, and that it was largely absorbed in abstract and academic concepts. But now we are witnessing a world conflict in which these academic concepts play an enormous part and motivate the thinking of many of the actors. How practical it is then to keep these concepts free from distortion and to expose the fallacies which they engender!

In conclusion, let me congratulate the Cranbrook Institute and its director, Dr. Robert Hatt, on the splendid exhibit they are presenting this evening. It is, I think, a highly encouraging omen that they should take this pioneering step in the education of the public to understand the truths of racial and cultural variations. All too often the educational institutions and the museums of the country have shied away from their social duty in popularizing scientific knowledge when social problems are involved. It has always seemed to me an incomprehensible policy since it seems to imply that science is useful only when it can serve no purpose and useless when it has something to say. If we believe in science, let us bring it forth.

OBITUARY

WILMON NEWELL
1878–1943

. . . the work never is done while the power to work remains.

—*Mr. Justice Holmes.*

WORK was a passion with Wilmon Newell, as the record of his life reveals. He believed in hard work, seemed to have a thirsty zest for it, and he, setting the example, insisted on all those who were associated with him exerting their best and most efficient effort. He accomplished much in his field, but expressed regret at the end because "There are so many things I want to do."

His two greatest achievements—eradication of citrus canker and eradication of the Mediterranean fruit-fly—saved the citrus industry of Florida and the nation. Citrus canker, a disease spread by a bacterium, came to Florida in 1911 on trees of trifoliate orange and satsuma from Japan and was recognized as a very dangerous menace to the citrus industry in 1914. Shortly after Dr. Newell assumed his duties as plant commissioner for Florida in 1915, he resolved, with surgical decision, to remove the canker growth from the industry.

The magnitude of the eradication task is recognized by bacteriologists and plant pathologists and is clearly shown by the record. Cankerous trees were found on 515 properties in 26 Florida citrus counties, and the only way in which it could be stamped out was to burn the affected trees. Nearly 250,000 grove trees and 2,740,000 nursery trees were destroyed in Florida, while 840,000 grove trees were destroyed in other citrus-producing Gulf states. The eradication campaign required twelve years and cost more than two and a half million dollars, but it succeeded in removing the canker threat to the nation's citrus industry.

Newell's second task for himself and his Florida Plant Board staff came in 1929, after his work and leadership in the canker campaign and other agricultural activities had, eight years before, resulted in his appointment to the dean's chair in the University of Florida College of Agriculture and director of the university's agricultural extension service and agricultural experiment station. The Mediterranean fruit-fly was discovered in a grove near Orlando, and a prompt survey revealed that it had spread to 20 of the state's heaviest producing counties. After learning that the fly had been found in Florida, Newell's decision was almost immediate: eradicate.

The Federal government approved of his eradication proposal and provided the major part of the funds for prosecuting the vigorous campaign which culminated eighteen months later in triumph over the pest. A greatly augmented Plant Board staff, many entomologists and hundreds of other workers were necessary to carry out the campaign. Since 1931 there has been no evidence of the fly in Florida.

These successful campaigns—against the canker and the Mediterranean fruit-fly—are considered two of the most remarkable achievements in the whole history of man's warfare against plant pests.

Before going to Florida, Newell served as entomologist in his native state of Iowa, in Texas, Georgia and Louisiana, and it was while he was chief entomologist for the Louisiana Crop Pest Commission that he developed the method of dusting with lead arsenate to control the cotton boll weevil and completed studies on the Argentine ant which provided the basis for control of this pest.

While in Texas he made extensive studies of bees and carried on bee-breeding experiments. He also originated the practice of burning colonies infected with American foul-brood to eradicate this disease, a practice that has been widely adopted by apiculturists.

In Florida, as director of the university's experiment station and, later (1938), as provost for agriculture at the university, his research activities were primarily of an administrative nature, his efforts being largely responsible for the great expansion of the experiment station and the employment of outstanding men to work on the state's agricultural problems.

His interest in the tung tree was responsible for the development of the tung industry in Florida and other Southern states. He initiated research at the Florida station which showed conclusively that tung trees could be grown profitably in the United States, and this research led to expansion of plantings to other states.

Always cognizant of the value of the great Everglades region, he inaugurated experiments which revealed that the fertile soil would produce bumper crops if it received applications of copper sulphate in the proper amounts. Rapid development of the highly important winter vegetable industry followed.

Research in all branches of Florida agriculture made noteworthy progress during his administration and the state's farmers, growers and livestock producers have received great benefits from the findings of the institution.

As director of the university's extension service, he employed well-trained, efficient and earnest men and women to carry on demonstration work over Florida, and the result has been notable improvement in individual farming and rural living.

In his desire to accomplish and serve he never spared himself and he asked the best and most energetic efforts, likewise, of those who served with him. He achieved much and the people of Florida and the nation have benefited from his labors.

HAROLD MOWRY

FLORIDA EXPERIMENT STATION

DEATHS AND MEMORIALS

AUGUST BUSCK, who served in the U. S. Department of Agriculture for more than forty-five years as specialist in Microlepidoptera, died on March 7 at the age of seventy-four years.

DR. MARGARET E. MALTBY, associate professor of physics, retired, of Barnard College, Columbia University, died on May 3 at the age of eighty-three years.

DR. LIONEL ROBERT WILBERFORCE, professor of physics at the University of Liverpool from 1900 until his retirement in 1935 with the title emeritus, died on April 1 at the age of eighty-two years.

THE Smithsonian Institution, Washington, has been given a portrait of the late Dr. George Washington Carver. The presentation was made on May 2 by Vice-President Wallace.

A RESOLUTION to designate February 11 of each year as Thomas Alva Edison Day in commemoration of his birthday was introduced in the Senate on May 2.

SCIENTIFIC EVENTS

THE U. S. NATIONAL MUSEUM

IN his report on the condition and operation of the U. S. National Museum for the fiscal year ended June 30, 1943, Dr. Alexander Wetmore, director of the U. S. National Museum, states that appropriations for the maintenance and operation of the museum for the year amounted to $892,630, which was $61,652 more than for the previous year.

Although there has been a decrease in the total number of visitors to the museum below that normal for times of peace, the number recorded, 1,355,269, indicates the great interest that exists in the exhibits. The change in hours to allow the public halls to be open all day Sunday has permitted many people to visit the buildings whose time schedules would not have otherwise made such visits possible. This is particularly true of service men and women, about 2,000 of whom have been included among the visitors each week end.

Last year's report described steps taken for the adequate safeguard of collections. These precautions have gone forward, and a program of training has been initiated among groups of employees for the protection of visitors, employees and the various buildings. Air-raid alarm systems have been installed, fire-fighting, air-raid and first-aid equipment procured, air-raid shelters designated, and complete black-out facilities where necessary established. Practice air-raid drills were held, both in cooperation with the District of Columbia and independently of the city-wide drills.

Throughout the year members of the staff have been occupied with work connected with the conduct of the war, either through direct contact with various war agencies or through the Ethnogeographic Board. This has included "spot" information in various fields, research and experiment. The variety of these subjects is indicated by the following enumeration of some of the items on which data were requested: Camouflage plants; natural vegetation of specific regions; illustrations of poisonous plants and of emergency food plants and data regarding them; destruction and mosquito-harboring epiphytes; distribution of certain plants of known economic importance; botanical exploration; the palatability of the flesh of land, freshwater and marine animals, their use for food and methods of capture; the serviceability of hides and skins for various purposes; disease transmission; noxious, poisonous or otherwise dangerous animals; intermediate hosts of animal and human parasites; aid in the preparation of survival manuals and other military and naval handbooks; distributional lists of insects and other animals of medical importance; outlines for insect surveys in foreign areas; instruction in mosquito identification; collection and preservation of specimens, especially those of medical importance; supplying duplicate sets of insect material not otherwise readily obtainable for the use of Army and Navy medical schools; biological and oceanographic problems; marine fouling organisms; bibliographic surveys; recommendations regarding personnel.

Assistance has been given in the identification of tribal culture patterns chiefly of the island peoples of the West Pacific area and of continental southeastern Asia. Other information provided, in this instance obtained from museum photographic files, related to the need of our aviators and soldiers to recognize religious caste markings, and, to assist in the orientation of aviators, the types of house construction in various parts of southern Asia. A mass of information directly based on the collections was given to such agencies as the Board of Economic Warfare and the War Production Board, bearing directly on the development of the use of substitute materials for civilian use. Various articles describing the more remote

peoples and their cultures were prepared and published.

The museum collections were increased by 230,231 specimens, which were included in 1,177 separate accessions. Because of wartime conditions a decrease of 211 accessions, 54,351 specimens, in comparison with the number received during the previous year, was not unexpected. The five departments registered specimens received as follows: Anthropology, 2,514; biology, 213,823; geology, 9,725; engineering and industries, 2,266; and history, 1,902. Most of the accessions were acquired as gifts from individuals or as a transfer of specimens by government departments.

THE NEW ENGLAND ASSOCIATION OF CHEMISTRY TEACHERS

THE sixth annual summer conference of the New England Association of Chemistry Teachers will be held from August 24 to 28 at Connecticut College, New London. The program will include a symposium on oxidation-reduction and papers on recent developments in various fields of chemistry. Consideration will also be given to post-war teaching problems in the sciences.

Although the summer conferences are held primarily for the benefit of members of the association any one interested will be welcome. Connecticut College, a privately endowed liberal arts college for women, opened for study in 1915. It is situated on a hill-top overlooking the town of New London, Long Island Sound, the Thames River and the hills of eastern Connecticut. A spacious campus surrounding modern granite buildings is supplemented by a hundred-acre arboretum with lake and out-of-door theater. Ocean Beach Park, a new recreation and bathing beach conducted by the City of New London, can be reached in twenty minutes by convenient bus service.

New London is situated midway between New York and Boston on the Shore Line of the New York, New Haven and Hartford Railroad; excellent roads from several directions are available to those able to go by automobile, and bus service is frequent. The summer session of the college will be in progress during the period of the meeting.

Details concerning fees will be published in the June issue of the *Journal of Chemical Education* and the complete program will appear in the July issue. All communications concerning the conference should be addressed to the secretary, Miss Helen Crawley, 45 Lawton Road, Needham, Mass.

ACQUISITION OF A BIRD COLLECTION BY THE NEW YORK STATE MUSEUM

THE section of zoology of the New York State Museum in Albany on April 15 acquired through purchase a notable collection of birds. The collection consists of 390 study skins representing 165 species and subspecies collected principally in Lewis County, New York, by the late James H. Miller, of Lowville. A few of the species represented were taken in Connecticut and Florida.

Mr. Miller, who died in November, 1943, was one of the collaborators of the late Professor E. H. Eaton in the preparation of his notable study of "Birds of New York" (New York State Museum Memoir 12, Part 1, 1910; Part 2, 1914). For that publication Mr. Miller contributed many records, photographs and other data. This information was supplied in part through the specimens which he collected in Lewis County and which comprise the bulk of the recently acquired collection.

Most of the skins were prepared by Mr. Miller and are beautifully done. Each specimen bears collecting and other data on the specially printed tags which he designed. The birds were taken between the inclusive dates 1881 and 1916 and are in an excellent state of preservation.

In addition to the specimens themselves, the museum has come into possession of the oak storage cabinet in which they were housed and which Mr. Miller made with his own hands; also his handwritten catalogue pertaining to the collection, an abbreviated journal relating to certain of his ornithological observations in the Lowville area and a few other incidental items.

Among the rarer New York State specimens in this collection are three Canada spruce grouse, a golden eagle, two Brunnich's murres, a great gray owl and two northern ravens. Several interesting seasonal and distributional records also are confirmed by specimens, as are other features of ornithological interest.

The collection in question is of considerable importance and value to ornithologists of the northeastern states generally and to those of New York State in particular. It provides tangible data of scientific, historical and sentimental value. Its final resting place in the State Museum could not have been more appropriately chosen.

A complete annotated list of the material in this collection is in course of preparation and in due time will be made available to those who may be interested.

DAYTON STONER,
State Zoologist of New York

THE ANNUAL SESSION OF THE AMERICAN MEDICAL ASSOCIATION

THE *Journal* of the American Medical Association for May 6 prints the program for the ninety-fourth annual session of the association to be held in Chicago from June 12 to 16 under the presidency of Dr. Herman L. Kretschmer, professor of urology at the Rush Medical College. Editorial comments in the *Journal*

on important events of the meeting read in part as follows:

The program indicates the great advance that has been made by medical science in recent years. Panel discussions on tropical medicine, chemotherapy, plasma and neuropsychiatry, already arranged for the general scientific meetings, emphasize these chief lines of interest.

The very first paper scheduled for the section on practice of medicine deals with penicillin. Additional manuscripts cover current topics, such as rheumatic fever, and there is a panel discussion on vitamins, amino acids and enzymes. In the Section on Surgery the use of surgical technics in hypertension and new technics related to methods of suture are featured. The opening session of the Section on Obstetrics is concerned with problems of pregnancy, but attention is given also to new studies with hormones and to complications related to the bladder. A symposium on penicillin features the Section on Laryngology, and one on rheumatic fever appears in the Section on Pediatrics. Unusual is the symposium on the abuse of rest in the treatment of disease, scheduled for the Section on Experimental Medicine. Prominent in the program on nervous and mental diseases is the panel discussion on operational fatigue in combat air crews. All the newer investigations in the intensive and modern treatment of syphilis are included in a full session of the Section on Dermatology and Syphilology; in these discussions the investigators who have been doing most of the work for the Office of Scientific Research and Development are cooperating. New attitudes in industrial medicine and a consideration of the relocation of physicians in the postwar period are listed for the Section on Preventive and Industrial Medicine and Public Health. In the Section on Urology the new advances in the treatment of cancer of the prostate are noted, and in the Section on Orthopedic Surgery space is provided for the report of the committee which is making a joint investigation of the Kenny technic. The Section on Anesthesiology gives opportunity to hear the last word on continuous caudal analgesia. Especially interesting also are the sessions of the Section on Miscellaneous Topics, devoted on this occasion to the interests of the general practitioner.

The scientific exhibit and the other usual features of the annual session will be up to the standard of peacetime and will be high-lighted as well by the interests associated with the needs of war. Attention is called to the motion picture theater, which will offer continuously from the first day the latest demonstrations utilizing visual education.

A specially arranged feature for this session is the war meeting planned for Wednesday night, June 14, at the Medinah Temple. This program will include not only the Surgeons General and other distinguished representatives of our own armed forces but also representatives of some of the United Nations.

The sessions of the House of Delegates of the American Medical Association will begin on Monday, June 12.

IN HONOR OF ALEXANDER PETRUNKEVITCH

Two hundred colleagues and former students of Dr. Alexander Petrunkevitch, since 1917 professor of zoology at Yale University, a well-known authority on spiders, who will retire this June after serving for thirty-four years on the faculty of the university, were present at a meeting held in his honor on May 3 at the Connecticut Academy of Arts and Sciences.

The surprise gathering was held at 8 o'clock P.M. in the Osborn Zoological Laboratory. The speakers included Edgar S. Furniss, provost of the university, and Charles H. Warren, professor of mineralogy and dean of the Sheffield Scientific School; George Vernadsky, research associate in history of the Connecticut Academy of Arts and Sciences; Dr. Lorande L. Woodruff, professor of protozoology; Dr. Roger B. Friend, lecturer in forest entomology, a former student; and Dr. Ross G. Harrison, Sterling professor of zoology, emeritus, director of the National Research Council.

Dr. Petrunkevitch was presented with two bound volumes containing forty-three manuscripts on history, arachnology, experimental zoology and general zoology, prepared by his colleagues and former students, now scattered throughout the world.

Several of the papers, by leading arachnologists from England, Brazil and Tasmania, as well as from all parts of the United States, contain accounts of new species of spiders which have been named in his honor.

The volumes include a portrait by Stanley C. Ball, associate professor of biology, an appreciation by Professor Woodruff and an account of the life and works of Dr. Petrunkevitch by G. Evelyn Hutchinson, associate professor of biology.

SCIENTIFIC NOTES AND NEWS

THE University of Rochester will at its commencement on May 14 confer honorary degrees on Joseph W. Barker, dean of engineering at Columbia University and special assistant to the Secretary of the Navy in formulating policies on all Navy college-training programs, and on Dr. George W. Corner, director of the department of embryology at Baltimore of the Carnegie Institution of Washington. Dr. Corner was for sixteen years professor of anatomy at the School of Medicine of the University of Rochester.

THE University of Wisconsin will confer the degree of doctor of science on Dr. Jesse T. Littleton, physicist, assistant director of research and development

with the Corning Glass Works, New York. The doctorate of laws will be conferred on Arthur J. Glover, for forty years editor of *Hoard's Dairyman*.

THE University of Birmingham, at a special congregation in July, will confer the honorary degree of M.D. on Dr. H. Guy Dain, chairman of the Council of the British Medical Association.

DR. LUDVIG HEKTOEN, executive director of the National Advisory Cancer Council of the U. S. Public Health Service, on April 8 was awarded the gold-headed cane of the American Association of Pathologists and Bacteriologists "in recognition of his distinguished service to pathology and his unselfish devotion to the highest ideals of the profession."

THE New England award for 1944 was presented on May 5 by the Engineering Societies of New England to Dr. Sanford A. Moss, consulting engineer of the General Electric Company. The presentation was made by H. C. Hamilton, president, who said: "Widely recognized for his creative work in the development of compressors, steam and gas turbines and turbo superchargers, honored as well for his exceptional service to our nation through a period embracing two world wars, this certificate is presented with the affection and esteem of his fellow engineers in New England."

THE Society of Chemical Industry, Canada, has awarded its medal for 1944 to Dr. Otto Maass, chairman of the department of chemistry of McGill University, "in recognition of his outstanding contribution to chemistry in Canada, both at the university and in industry."

A SURPRISE party was given on April 29 to Dr. John R. Murlin, professor of physiology at the University of Rochester and director of the department of vital economics, in celebration of his seventieth birthday. Approximately fifty former and present students and associates were in attendance. After the dinner, Professor Murlin was presented with letters from his many associates who were unable to be there and with informal snapshots of all his former associates, to be arranged in a leather album as a "Vital Economics Family Album." The program was completed with a humorous skit entitled "Life with Father."

AT the Milwaukee convention of the Electrochemical Society, honorary membership certificates were awarded to Paul J. Kruesi, president and general manager of the Southern Ferro Alloys Company, and to Dr. Willis R. Whitney, honorary vice-president of the General Electric Company, non-resident professor of chemical research at the Massachusetts Institute of Technology.

A PORTRAIT of Colonel Harold W. Jones will be presented at 5 o'clock on May 13 to the Army Medical Library in recognition of his contribution to the advancement of medicine and particularly his adoption of microfilm copying as a legitimate extension of the service rendered by the library to those at a distance. On this occasion the enlarged installation of the Photoduplication Service of the library will be open to inspection.

DR. ALBERT L. MIDGLEY was tendered on April 19 a testimonial dinner by the Rhode Island Board of Dental Examiners in recognition of thirty-five years of consecutive service on the board and of notable contributions to the advancement of dentistry.

THE installation program of the Vanderbilt University Chapter of the Society of the Sigma Xi was held on April 15 under the direction of the installing officers, Dr. George A. Baitsell, of Yale University, and Dr. Fernandus Payne, dean of the Graduate School of Indiana University. The dinner program on this occasion was attended by members of the newly inaugurated chapter and all members of the scientific staff of the university. Addresses were made by the chancellor of the university and by the installing officers. A paper, entitled "Some Biological Interrelationships," prepared by Dr. E. Carroll Faust, professor of parasitology at the School of Medicine of the Tulane University of Louisiana, was presented on this program. Officers of the new chapter are Dr. Louis J. Bircher, professor of physical chemistry, *President*, and Dr. John A. Hyden, professor of mathematics, *Secretary-Treasurer*. There are forty-four charter members of the new chapter.

DR. TORALD H. SOLLMANN, head of the department of pharmacology of Western Reserve University and dean of the School of Medicine, who reached the age of seventy years on February 10, will retire on June 30. He plans to continue research in pharmacology. Dr. Sollmann has been a member of the staff since 1895, when he became demonstrator in physiology. He will be succeeded as head of the department of pharmacology by Dr. Arnold D. Welch, research director of Sharpe and Dohme, Glenolden, Pa.

DR. H. H. ANDERSON, formerly of the Peiping Medical College, has been appointed professor of pharmacology and chairman of the department of the newly reorganized division of pharmacology of the Medical School at San Francisco of the University of California. Dr. Anderson in 1937 became associated with the Council on Medical Education and Hospitals of the American Medical Association, studying medical education. He then was made professor of pharmacology at Peiping. On December 7, 1941,

he became a prisoner of war, and was exchanged in December, 1943.

DR. ITALO F. VOLINI, since 1929 professor and head of the department of medicine of the School of Medicine of Loyola University, has been appointed dean of the school for the duration of the war. He will take the place of Commander Francis J. Braceland, on leave with the Navy.

DR. GEORGE W. WILSON has been appointed dean of the School of Dentistry of Marquette University. He succeeds Dr. Henry L. Bauzhaf, who has been made dean emeritus.

DR. FLORENCE L. BARROWS has been appointed assistant professor of botany and chairman of the department of botany of Wheaton College, Norton, Mass.

AT the University of London, Dr. J. M. Mackintosh has been appointed from October 1 to the chair of public health, tenable at the London School of Hygiene and Tropical Medicine.

DR. OTIS W. CALDWELL, of the Boyce Thompson Institute for Plant Research at Yonkers, N. Y., general secretary of the American Association for the Advancement of Science, has become a member of the Board of Trustees of Science Service.

DR. EUGENE M. LANDIS, professor of physiology at the Harvard Medical School, has been elected a member of the Council on Pharmacy and Chemistry of the American Medical Association, to fill the unexpired term of Dr. William C. Rose, professor of biochemistry at the University of Illinois, who has resigned owing to the pressure of other work.

DR. A. L. ROBINSON, professor of chemistry at the University of Pittsburgh, has been placed on half time by the department of chemistry so that he may serve as acting librarian of the university. Dr. Robinson has been chairman of the Library Committee of the department for many years, and for the past several years has been chairman of the Senate Committee on Library and Publications of the university.

WALTER G. CAMPBELL, U. S. Commissioner of Foods and Drugs of the Federal Security Agency, previously from 1933 to 1940 chief of food and drug administration of the U. S. Department of Agriculture, has retired.

DR. JOEL B. PETERSON, research chemist of the White Laboratories at Newark, N. J., has joined the department of applied research of Standard Brands, Inc., as technical consultant for pharmaceuticals.

THE thirteenth Joseph Henry Lecture, entitled "Faster Than Sound," was delivered on April 29 before the Philosophical Society of Washington by Dr. Theodor von Kármán, director of the Guggenheim Aeronautics Laboratory of the California Institute of Technology.

DR. WILLIAM H. SEBRELL, chief of the Division of Chemotherapy of the National Institute of Health, will deliver on May 18 the eighth Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "The Relation between Sulfonamide Drugs and Vitamin Deficiencies."

THE annual oration of the Massachusetts Medical Society will be delivered by Dr. Joseph C. Aub, associate professor of medicine at the Harvard Medical School, at the annual meeting to be held on May 22, 23 and 24. He will speak on "The Toxic Factor in Traumatic Shock." The Shattuck Lecture will be given by Dr. Alfred Blalock, professor of surgery at the School of Medicine of the Johns Hopkins University. The lecture is entitled "A Consideration of Certain Recent Advances in Surgery."

DR. ROBERT CUSHMAN MURPHY, of the American Museum of Natural History, lectured on April 14, Pan American Day, before the students and faculty of Smith College. He spoke on "Climate, Nature and Man in Northwestern South America."

DR. VALY MENKIN, of the Fearing Research Laboratory of the Free Hospital for Women at Brookline, Mass., was the guest speaker on April 24 at the meeting at the University of Michigan of the American Academy of Periodontology. He gave two lectures on the "Dynamics of Inflammation."

DR. WALTER R. MILES, professor of psychology at Yale University, at a meeting on April 20 of the Iowa State College Chapter of the Society of the Sigma Xi, discussed psychological problems arising under conditions of military flying. His lecture was entitled "Psychology and Military Aviation."

THE centenary of the American Psychiatric Association will be celebrated at a meeting to be held in Philadelphia on May 15 and on the three following days. Advances made in military psychiatry and the steps now being taken to rehabilitate psychiatric casualties will be discussed. Other subjects on the program include child delinquency, psychological first-aid in the public health service, industrial mental hygiene, child psychiatry and psychiatric nursing, convulsive shock therapy, pre-frontal lobotomy, electroencephalography, psychosomatic medicine, alcohol neuroses and sleep disorders. There will be sessions devoted to psychiatry and the United States Army, psychiatry and the United States Navy, rehabilitation and psychoneuroses. The meeting will be formally opened on Monday morning, with Dr. Edward A.

Strecker, of the University of Pennsylvania, presiding. The incoming president, Dr. Karl M. Bowman, of the Medical School at San Francisco of the University of California, will be inducted into office on Thursday.

THE celebration of the sixtieth anniversary of Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York, N. Y., opened on May 6. There were no formal anniversary exercises. May has been designated as anniversary month with special emphasis on cancer education for the public, and a series of lectures on "The Challenge of Cancer" will be given on successive Saturdays at 11 A.M. in the hospital auditorium.

A NEW laboratory specially equipped with high-frequency heating apparatus has been established by the department of chemical engineering of Columbia University. It will have the cooperation of technical experts of the Induction Heating Corporation of New York, which provided the high-frequency equipment for the laboratory. The department of chemical engineering will have full authority in guiding the program and in publishing the results of research. The laboratory is under the direction of Professor Arthur W. Hixson, head of the department, and Professor Philip W. Schutz. Everette K. McMahon, a graduate of the Georgia Institute of Technology, specialist in the applications of high-frequency heating, is in charge of the laboratory.

DISCUSSION

BASIC BIOLOGY AND GENERAL EDUCATION

IT is unfortunate that the multiplicity of objectives of college and university students has not been brought to the fore in the recent discussion of the teaching of general biology, which is part of a very important and far-reaching problem in college and university teaching.[1, 2] It is likely that few scientists would disagree with one of the writers cited[2] that for the education of professional biologists, detailed and systematic introductory courses in each of several important branches of biology are indispensable. However, it is not for such students that courses of more comprehensive scope and less complete detail should, in the opinion of the present author, be designed or offered.

It is unfortunately a fact that very large fractions of college and university students now leave such institutions without appreciable contact with modern science. Our choice as educators in science is not between presenting the broad range of knowledge about nature to students in many systematic courses covering individual areas of specialization, and its presentation in a more comprehensive manner. The limitations of time in four college years make it impossible to include a detailed treatment of even the major subdivisions of the sciences along with the other desirable content of the modern college curriculum. The practical alternative which is actually open to us seems to be the choice between the more comprehensive and less detailed course and nothing.

The peculiar virtue of the American educational system is its extensiveness. The American system has many weaknesses, but it has apparently been good enough to allow the people to operate a reasonably satisfactory democratic system. Our colleges and universities may be inferior to some others, for example, the old German, in intensiveness of training offered to the majority of their students. It does not follow, however, that they perform a less useful service. To provide a modicum of college training to about ten times the proportionate number of young people in the population is an achievement of American education to be borne in mind when the virtue of one or another educational policy is to be decided. Such education has apparently performed a great service in the past by creating a broad base of fairly well-informed citizens in the democracy. But our training of students in science is becoming poorer by the year because of the greater emphasis on vocational and professional training. The teaching of science has reached a low ebb, as far as non-science students are concerned. Something constructive will have to be done to turn the tide. Our old offerings have been rejected. The present problem is to find new ways to accomplish old ends.

We are living in an age of greatly expanding knowledge in science. If our people are to have some useful appreciation of this increase in scientific information is it not reasonable that the colleges and universities should offer their students courses with broad enough scope so that an introduction to the whole range of science is possible within the limitations of time of a college curriculum? This question can not be answered by evasion because it is on the public mind as well as our own. If we do not give a satisfactory answer, the public or college administrators may give it for us in the form of a directive, perhaps less congenial to us and less useful to society than our own solution could be.

The problem of specialized versus general courses is not one of either-or. There is no bar to maintaining every essential introductory course in a field of specialization, designed for smaller numbers of serious stu-

[1] Gordon Alexander, SCIENCE, Vol. 99, January 28, 1944.
[2] C. A. Shull, SCIENCE, Vol. 99, March 10, 1944.

dents in related fields, and at the same time offering to the large mass of students without such professional objectives an opportunity to get at least a bird's-eye view of the field under competent tutelage. In many instances existing courses for non-technical students can be altered, combined or rearranged to meet the existing need. If some such solution is not found we shall have no right to complain when the American people derive their notions about evolution from William Jennings Bryan, about animal experimentation from Irene Castle or William Randolph Hearst and about medicine from B. J. Palmer or Mary Baker Eddy.

A university must and does serve many functions. It seems that it is not too much to ask that it carry out its job of giving its graduates as least a speaking acquaintance with the scope of science. The vexatious problem of the vested interests of specialty groups, anxious to avoid loss of prestige and financial support through a decrease in numbers of students in existing courses, should not be allowed to stand in the way of achievement of a goal, larger by far for both science and society than the disarrangements it will require for its achievement.

As a specialist in a branch of biology directly involved in the program under discussion, I am anxious to see the most important facts and principles of that branch be known and appreciated by as large a fraction of the public of which we are a dependent part, as is reasonably possible. I am convinced, first, that there will be no loss in prestige or economic support for that science as a consequence, and second, that such education will improve and enrich the lives of the generation acquiring it. It seems very likely that the whole realm of basic sciences would receive the greatest impetus possible if the people at large had even the barest sort of conception of how applied science rests upon progress in pure science. Many scientists to-day complain bitterly about the partiality of the public in the support of applied as opposed to pure science. There is little to be wondered at in such discrimination, since any one who can read knows something about the achievements of applied science. If we in the basic sciences are unwilling to play our part in mass education in the essentials of the pure sciences we shall have no one to thank but ourselves for the discrepancy in support that will result.

A corollary of the argument I have made is that professional students of science need a great deal more acquaintance with the literary, artistic and social heritage of the human race than they now acquire. The general cultural education problem has many facets, and although I have stressed only one because it is in my province as a teacher, I can not refrain from inserting the suggestion that the general education of scientists, pure and applied, deserves a much greater emphasis upon cultural phenomena than it has received in the recent past, and that comparably comprehensive presentations in these areas will assist greatly in meeting this need.

A move in the direction of less fragmentation into small subdivisions in the teaching of science to students without professional objectives in the areas in question seems to offer the best hope we have for the restoration of opportunity to college students to acquire a liberal education in the best sense. It presents an opportunity to make many more citizens intelligently aware of the importance of basic science to applied science and human welfare. It need not detract an iota from the thoroughness of training of specialists in science, nor decrease the prestige or financial support of basic science departments. In fact, it seems that to extend support for work in the basic sciences, greater public appreciation of their important role in human welfare is much needed.

MAURICE B. VISSCHER
UNIVERSITY OF MINNESOTA

GREGOR MENDEL'S EXPERIMENT ON THE NATURE OF FERTILIZATION

IN "The Evolution of Genetic Systems," C. D. Darlington reviews "the three vital experiments" on which modern genetic principles are founded: 1—the proof by Johannsen that the genotype is independent of the environment; 2—the proof by Gregor Mendel that the genotype is composed of indivisible parts; 3—the proof by the same Mendel that fertilization and normal plant development involve the union of one egg and one pollen-grain.

While Johannsen's beans and Mendel's peas have become classical, Mendel's second contribution has remained almost unknown. In a seminar course "based principally on outstanding contributions that have marked great advances in the theory and the application of genetics," we have retrieved this Mendel experiment, locating the account in the eighth of the ten letters from Mendel to the German botanist, Carl Nägeli.[1]

It is interesting that Mendel conducted his experiment in 1869, five years before Oscar Hertwig observed the fusion of egg and sperm nuclei of sea urchins and thus discovered the basic principle of fertilization.

How little understood this principle was only seventy-five years ago can best be appreciated by quoting that passage of Darwin's[2] which caused Mendel to undertake his experiment:

[1] "Gregor Mendel's Briefe an Carl Nägeli, 1866–1873," Herausgegeben von C. Correns. *Abhandlungen der Mathematisch-Physischen Klasse der Königlich Sächsischen Gesellschaft der Wissenschaften*, 29: 3, 235–236, 1905.

Quatrefages has shown in the case of the *Teredo*, as did formerly Prevost and Dumas with other animals, that more than one spermatozoon is requisite to fertilize an ovule. This has likewise been clearly proved by Newport, who adds the important fact, established by numerous experiments, that, when a very small number of spermatozoa are applied to the ova of *Batrachians*, they are only partially impregnated, and the embryo is never fully developed; . . . With respect to plants, nearly the same results were obtained by Kölreuter and Gärtner. . . . The pollen-grains of *Mirabilis* are extraordinarily large, and the ovarium contains only a single ovule; and these circumstances led Naudin[3] to make the following interesting experiment: a flower was fertilized by three grains and succeeded perfectly; twelve flowers were fertilized by two grains, and seventeen flowers by a single grain, and of these one flower alone in each lot perfected its seed, and it deserves especial notice that the plants produced by these two seeds never attained their proper dimensions, and bore flowers of remarkably small size. From these facts we clearly see that the quantity of the peculiar formative matter which is contained within the spermatozoa and pollen-grains is an all-important element in the act of fertilization, not only in the full development of the seed, but in the vigour of the plant produced from such seed.

The following is Mendel's own story of his experiment:[4]

Because of my eye trouble, I was unable last year to undertake further hybridization experiments. Only one experiment appeared to me so important that I could not make up my mind to postpone it to some later date. It deals with the view of Naudin and Darwin that a single pollen-grain is not sufficient for an adequate fertilization of an egg. As experimental plant I used *Mirabilis Jalappa*, as did Naudin; the result of my experiment, however, is an entirely different one. I obtained from fertilization with single pollen-grains eighteen well-developed seeds and from them as many plants, ten of which are already in bloom. The majority of these plants are just as fully developed as those derived from free self-pollination.

A few specimens, however, have until now lagged somewhat in growth, but to judge from the success of the others, the reason can only be found in the circumstance that all pollen-grains do not possess the same faculty to fertilize; and, furthermore, that in these particular experiments the competition of other pollen-grains was excluded. Where several compete, we may assume that always the strongest succeeds in alone effectuating the fertilization. However, I intend to repeat these experiments; also one should be able by an experiment to ascertain directly whether in *Mirabilis* it is possible for two or more pollen-grains to participate in the fertilization of one egg. According to Naudin at least three would be required!

TAGE U. H. ELLINGER
U. S. DEPARTMENT OF AGRICULTURE
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FACILITATE HUMAN ENDEAVOR THROUGH COLLEGE TRAINING IN SCIENTIFIC METHOD

DR. ANTON J. CARLSON makes several points in his statement about Dr. Cattell's service to science[1] that need a lot more emphasis: (1) "Scientific method should be applied to all fields of human endeavor; (2) education (even in the sciences) is largely memory conditioned by traditions and faith rather than by the exercise of reason based on understanding; (3) human curiosity, human want and human pain are potent spurs; (4) keep your mouth shut and your pen dry till you know the facts."

Most of us will agree with the good doctor "that all men should have a good workable knowledge of scientific method," but he would be the first to point out, I am sure, that thus far the percentage of men who could thus qualify would be very small indeed.

The scientific attitude or viewpoint is comparatively rare, my observation forces me to say. The responsibility for this rests, in part, on our schools and colleges —or on what Dr. Carlson calls "the 'Quiz Kid' ideal of *what* rarely proceeding to the *evidence* and the factual *why*."

To capitalize on human curiosity, instead of stifling it as happens so often in our schools now, I suggest that our colleges offer a full year's course in "Scientific Methods," and that such a course be required of all freshmen.

The accompanying outline covers the essentials of such a course, I submit, because it is basic, fundamental, broad in scope and provides orientation through the active participation of leaders in the various fields of endeavor. It is my thought that every college student should get an idea (1) of the mechanics of thinking, analysis or research, both technical and market; (2) of what is being done in research in biology, chemistry. geography, physics, marketing, etc.; (3) of statistics, semantics, logic; (4) of personal aptitudes; (5) and that he should learn when to keep his mouth shut.

A Tentative Outline of a Year's Course in "Scientific Method":

(1) Spirit and basic principles of scientific inquiry (2).
(2) Current research activities, needs, opportunities (4).
(3) Isolation and statement of problems (1).
(4) Technical and market research methods, public opinion polls (6).

[1] SCIENCE, 99: 2565, 158, 159.

[2] Charles Darwin, "Animals and Plants under Domestication," Vol. 2, Chapter 27, pp. 435–436, 1868.

[3] M. Ch. Naudin, "Nouvelles recherches sur l'hybridité dans les végétaux," *Nouvelles Archives du Museum d'Histoire Naturelle*, Paris, Vol. 1, pp. 35–37, 1865.

[4] Excerpt from a letter written by Gregor Mendel to Carl Nägeli, dated July 3, 1870. (Translation from German.)

(5) Sources of research material (1).
(6) Readings in literature of research.
(7) Orientation in the various sciences and fields of endeavor (9).
(8) Aptitude tests and personal problems (2).
(9) Elementary principles of statistical methods (4).
(10) Semantics (4).
(11) Logic—with particular reference to fallacies (2).
(12) Presentation of research reports (1).

Obviously, such a course could not be handled by any one instructor; it should be handled by the leaders or best speakers in the various fields. One of the by-products of this would be considerable vocational orientation or guidance.

The numbers in parenthesis cover, tentatively, the number of weeks' study that I would devote to each of the various general topics.

This course is not presented as a panacea or cure-all—but it can help do some of the things that James McKeen Cattell fought for for over fifty years—and which Dr. Carlson advocates to-day—extend the use of scientific methods.

K. C. RICHMOND

CHICAGO, ILL.

STARRING SUBJECTS IN "AMERICAN MEN OF SCIENCE"

IN view of the long service rendered by J. McKeen Cattell to science in our country it would seem appropriate to devote considerable space to his life work in SCIENCE. I would be especially interested in a discussion of the advantages of starring men in "American Men of Science." It seems to me that it is very important for the progress of science that the achievements of those working in this field should become known more widely and more reliably than is now customary.

If the methods adopted by J. McKeen Cattell can be replaced by better ones it is highly important that this should be done. I realize that it is very difficult to find methods of procedure which will be generally acceptable, but this does not seem to be a sufficient reason for not considering the possibility of improvement. I have heard many favorable comments on the success of J. McKeen Cattell along this line, and it seems to me that we could honor him mostly by considering the possibility of improvements of his methods.

G. A. MILLER

SCIENTIFIC BOOKS

WILLARD GIBBS

Willard Gibbs. By MURIEL RUKEYSER. xi + 465 pp. New York: Doubleday, Doran and Company, Inc. $3.50.

I HAVE always found it hard to write about Willard Gibbs. Neither my brief biographical sketch in the Dictionary of American Biography nor my Gibbs Lecture before the American Mathematical Society seems to me quite satisfactory. It may be a significant fact that in the forty years since his death none of his pupils, colleagues or friends have written so extensively about him as an English science writer, J. G. Crowther, or a native poet, Miss Rukeyser, whose whole background seems very remote from that of Gibbs.

There are two excellent biographical notices of Willard Gibbs. The one first published is by H. A. Bumstead, his pupil and colleague for the last decade of his life; it prints fifteen pages at the head of the first volume of "The Scientific Papers of Willard Gibbs." The second is by C. S. Hastings, who was his pupil during the first year of tenure of his professorship of mathematical physics, and who, except for a brief period of service away from Yale, was his colleague until the time of his death; it fills about twenty pages of volume 6 of the "Biographical Memoirs" of the National Academy of Sciences. These two notices represent Gibbs as I knew him better than I can; they deserve the most careful study by all who would know him as he appeared to his contemporaries, old or young.

The sixty-five pages Crowther devotes to Gibbs leave me rather cold. They constitute an interpretation rather than a biography, and much of the interpretation seems very dubious. The start is from: "The problem of Gibbs is the discovery of the explanations of his simultaneous greatness and obscurity, the nature of his own work, the influence of his personal psychology and social environment, and the social history of the United States."

One who sets himself such a task can hardly do otherwise than mold objective facts to his subjective philosophies. So far as I can see, Gibbs never suffered obscurity in matters that really counted—professor at 32, subject of Maxwell's praise at 35, elected to the National Academy at 40, called to Johns Hopkins a year later, recipient of the Rumford Medal within another year, he seems not at all to have suffered the fate of Gregor Mendel or Hermann Grassmann.

Later Crowther writes: "Is it possible that Maxwell's intelligibility was a reward for social conscience, and that Gibbs's unintelligibility was a penalty for the belief that he had no duty to ensure that his discoveries were understood and used?"

As to intelligibility or unintelligibility let me say that in the days when I was teaching Maxwell's electromagnetic theory and Gibb's thermodynamics I cer-

tainly did not find that the former's "Electricity and Magnetism" was any more intelligible than the latter's "Equilibrium of Heterogeneous Substances." It is likely that such great new syntheses can not well be entirely perspicuous. Was Newton's "Principia" quite intelligible to his immediate contemporaries?

The psychoanalytic interpretation which Crowther offers for some of Gibb's characteristics and the statement that his mouth has a petulant, disagreeable curl (in a reproduction from an early daguerreotype) seem to me not only highly speculative but extremely doubtful. I have examined the original daguerreotype with care but can see no petulance, and as to mother fixation, transference to an elder sister, symbols of persistence of his father's authority, and the disappointment of an unconscious psychological motive, I can only say that nothing I ever heard about Willard Gibbs gives me any inkling that Crowther is on sound ground.

The attention given to Crowther's essay is a necessary precursor to Miss Rukeyser's work because she leans so heavily upon him. In place of his sixty-five pages she gives us four hundred and fifty, diluted with more (and more exaggerated) interpretations and inflated with much matter alien to the story of Gibbs and his work—Melville, Whitman, Percival, J. Q. Adams, Henry Adams and William James figure at considerable length. The book is the author's interpretation, not only of Gibbs and his work, but of the sweep of American history from before his birth to the present time. It is different history from any I have read and a different Gibbs from him I knew. The author is a literary woman rather than a historian or scientist; she states as facts a great many things she can not possibly know, such as what some one felt or thought on a given occasion, even though there be no record to indicate it. As fictionalized biography has a great present vogue, many must like it and some may even consider this one "thrilling" in the places where it is best written, though I should think any one must consider a good deal of it as both badly written and boresome.

Miss Rukeyser starts her book with a frontispiece portrait of Gibbs which is new to me and which I should never have recognized. On the flyleaf she places a quotation from William James: " 'They laugh best who laugh last.' Wait until we are dead twenty years. Look at the way they're now treating poor Willard Gibbs, who during his lifetime can hardly have been considered any great shakes at New Haven!"

Whether it is fair to take this quotation out of its context, I doubt, but it surely fits the author's purpose of drawing Gibbs as a prophet without honor in his own university or country. For over forty years I have discussed this matter with many persons and find few who consider it a just judgment.

> In livery, driving
> his sister's coach in the city.

So wrote Miss Rukeyser in her poem on Gibbs. She now takes this back in the sentence: "And the legends grew, until people would come to say that Willard Gibbs wore livery driving his sister to market, which was not only a lie, but ridiculous to anyone who knew the circumstances of New Haven, or the family, or the gentle habits of these people."

Nevertheless, she does not take back the general implication of Gibb's subordination to his sisters and, as in other passages in her poem, she maintains *à l'outrance* the thesis that he avoided life and living:

> Silent, inhibited, remote [p. 4].
>
> Gibbs tore himself down until his life was nothing but self and science, and then he tore the self away [p. 6].
>
> . . . a careful withdrawal from personal life, a careful destruction of personal tokens [p. 12].
>
> Hesitation had come to be a deep current in his life [p. 220].
>
> That was the pale life,—whose letters were torn up, burned, anyway destroyed [p. 430].
>
> All the burden of withdrawal has been his [p. 433].
>
> He carried the tragedy of his own restraint, and it grew into an immense and jungle growth [p. 436].

May the author live to recant also this exaggeration, calling it lies and ridiculous!

So far as those who knew him could judge Gibbs was one of the most happy and serene of persons. I can not do better than to quote Hastings:

> Nothing is more difficult in a biographical memoir than to give the reader a definite impression of the personal characteristics of an eminent man, of those characteristics which make the man in the eyes of such of his contemporaries as are unable to estimate him by his works. On the other hand there is no more legitimate curiosity than that which prompts us to seek such information about a man who has impressed himself upon his times by his essential greatness. In many cases a mere accumulation of incidents in the life of one who has numerous points of contact with his fellow-men is all that is necessary for a discerning reader; but with one whose activities are chiefly intellectual this is often difficult, and particularly so with Professor Gibbs, who seems never to have sought or desired a wide circle of acquaintances. But we should greatly err if we concluded from this that Mr. Gibbs was of an unsocial nature. To me he always appeared quite the opposite—perfectly friendly and approachable, ready to talk on any subject, and always equable, he exhibited a flattering welcome to every friend. Effusiveness was as foreign to his nature as insincerity, but cordiality was never wanting. He laughed readily and possessed a lively sense of humor.

There is one thing I might add. Time was when we did not so much concern ourselves with superficial "personality" or behavior as with the substratum called character, and when we believed that the university,

the church and the courts, however so much they might profit by talent, served their essential social purposes chiefly through the integrity of character of their personnel, through uprightness, sincerity and faithfulness to principle. It was the high character of Willard Gibbs that impressed me even more than his great talent.

Miss Rukeyser says of him:

> His faith lay in a few often repeated words which come down through the memory of his friends, his friends' children, his students:
>
> "Mathematics *is* a language."
>
> "The whole is simpler than its parts."
>
> "Anyone having these desires will make these researches."

I can not recall that Gibbs was ever trite or hackneyed; if he repeated these or similar sayings often, it certainly was not in my hearing; indeed I never before heard any one suggest that he made the third of these statements.

Miss Rukeyser tries hard to give an intelligible account of Gibbs's contributions to science. It is a difficult task. I shall not attempt to assess failure and success of this effort at popularization; I should, however, like to refer to two items:

> 1. This was a man whose acceptance of his culture seemed to stop short only at the borders of his scientific labor.

I believe that Gibbs's "acceptance of his culture" was as clear in his scientific work as it could have been anywhere else—neither more nor less. His work was done in that great period of culmination of the victories of Newtonian mechanics. About two hundred years after the "Principia," we find among other important contributions that, in the decade 1870–1880, Lord Rayleigh published his elegant "Theory of Sound," Maxwell his "Electricity and Magnetism," Gibbs his "Equilibrium of Heterogeneous Substances." Gibbs applied, with great care and exceptional intuition and with very wide acquaintance with physicochemical facts, the concepts of equilibrium mechanics, particularly the technique of virtual work, to systems that were heterogeneous, specifying with precision the conditions that must hold for the great variety of infinitesimal displacements from a state of equilibrium which were possible when the substances were heterogeneous.

> 2. As the influence of Gibbs's work grew, the tragic waste, directly or indirectly traceable to ignorance of the laws he had stated, became more dramatic. The most heroic appearance is the story found in full detail in the heartbreaking record of Captain Scott's expedition to the South Pole during the iron winter of 1912. Crowther repeats the belief that Scott and his party died through ignorance of the phase rule.

Crowther's statement is:

> It is said that the lives of the English explorers, Captain Scott and his party, were lost in the Antarctic, owing to ignorance of the phase rule. When they started on their return from the South Pole, they found the fuel oil can in one of their depots was empty. The solder of the can contained tin, which may exist in different phases. At low temperatures block tin may fall into powder, and cans soldered with it become unsealed. This appears to have happened to the cans upon which Scott depended for survival.

I can find nothing in the writings of Gibbs, all of which I have reread since undertaking this review, which would serve to predict what new phases will occur. He states in several places that this sort of knowledge must come from observation. He says nothing about tin, let alone solder, which contains a good deal of lead. Moreover, he emphasizes the existence of passive resistances to change of phase which permit substances to exist in states far beyond the limit of absolute stability.

I can find no evidence in the literature or from private advices which I have sought widely that in fact solder in cans does degenerate in the cold. Moreover, the rather competent scientific observers of the expedition report in the official account that the tins at the depots awaiting the Southern Party had been opened and the due amount to be taken measured out by the supporting parties on their way back, and they attribute the lack of fuel to evaporation or leakage through the stoppers.

However, this "heart interest story" is now in the literature through the statements of Crowther and Rukeyser and may well remain in it a long time; so, too, I fear, will a lot of other errors about Gibbs and his work which Miss Rukeyser has incorporated in her fictionalized biography, and for which I can see no excuse even in her political or social or emotional ideas or ideals.

Without extending the review to quite impracticable length, it would be impossible for me to list the items which I believe to be wrong, and in many cases it would be entirely out of the question to determine whether they were wrong. For example, she writes in connection with Gibbs's death: "His digestion had always bothered him, and suddenly he suffered a violent and acute attack." What may be her authority I can not guess. So far as my information goes Gibbs's digestion had always been satisfactory. His fatal attack, diagnosed as intussusception, need not have been and I believe was not preceded by any considerable premonitory period of indigestion. It is certainly not true to claim that he was a weak and sickly person. Yet that impression is so much created by Miss Rukeyser that one reviewer says of him that he prob-

ably would have found it difficult to drive a nail straight or hang a picture. This is entirely untrue—Gibbs had useful hands, but we all have heard of the fable of the three black crows! Truth grows by the application of controlled imagination, and untruth by imagination uncontrolled.

It was my privilege as a young man to become acquainted with a considerable number of distinguished scholars of the generation of Willard Gibbs who seemed to me to be much alike in their simplicity, dignity and friendliness—gentleman of the old school we youngsters called them. They did not wish to be hero-worshipped, they were not patronizing, they did not proselytize, they were living examples of what the best in university life has been, is now, and will be so long as there are youth who are inspired by such examples to try to become in all simplicity worthy successors to them.

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REPORTS

WARTIME INVESTIGATIONS AT MELLON INSTITUTE

IN the industrial research proceedings of Mellon Institute during its fiscal year from March 1, 1943, to March 1, 1944, as set forth in the thirty-first annual report of the director, E. R. Weidlein, there are many facts of professional interest. As the following summary reveals, the emergency has raised the levels of investigational capacity and thereby has increased research usefulness.

OUTSTANDING CERAMIC RESEARCH RESULTS

The physical and chemical treatment of gypsum, for its improvement and for obtaining new products, has been given thoroughgoing study during the past five years, with especially valuable results in 1942–3. The use of gypsum in the manufacture of light-weight refractories has been extended. An investigation of mottled or colored silica brick has been described and definition has been made of the effect of furnace gas pressure on the life of refractories. A number of urgent wartime high-temperature problems have been solved by the use of "Carbofrax" and "Monofrax." A new apparatus has been contrived for aging dry cold-set mortars. "Garsand," a novel glass-making material, was introduced. The multiple industrial fellowship on ceramic chemicals has been devoting the full time of its enlarged staff to research on problems in wire-wound resistors. Eight fellowships in all are in the field of ceramics.

ACHIEVEMENTS IN METALLURGY

Many effectual war implements have been formed by metallurgical studies on thirteen fellowships of the institute. Fundamental relations within the foundry cupola have been examined critically. Iron compacts of improved physical properties are a contribution to powder metallurgy; in addition, a new grade of sponge-iron powder possessing excellent compressibility and uniformity has been developed, several original uses of importance have been devised for iron powder, and the commercial production of silicon powder has been worked out. Desirable physical properties have been imparted to arc-deposited low-alloy steel through the employment of novel slag compositions. The failure of restrained welds and the destructive testing of structural joints, involving special gaskets, have had much attention, and protective coatings for steel storage containers are being investigated. A new flux for silver soldering came into extensive use in war industries and a copper-brazing flux was introduced. Advances were made in chromium plating of tools and gages. Many improvements have been achieved in shell manufacture, mainly in the production and finishing of casings and components. Lock-nut technology has been benefited by fundamental mathematical and physical studies. These results have brought the institute close to the zones of military action. Announcement was made of a differential solubility process for treating waste pickle liquor, and basicity factors were interpreted as aids in evaluating limestones and limes as neutralizing agents.

MUCH IS BEING DONE ON COAL PRODUCTS

Methods have been investigated for improving heating efficiency and for conserving anthracite; better procedures of control and operation have been prescribed for house-heating equipment. Smoke-producing tendencies in coals of various ranks have been under inspection. A large program of research on the hydrogenation, dehydrogenation, oxidation and alkylation of coal products has been widened considerably, and several new catalytic processes are under development. The recovery of low-boiling compounds from coke-oven by-products is an allied project. Physical procedures are being applied experimentally to separating coke-oven gas constituents. A new process of making ethylbenzene has been put in large-scale operation. Another investigation has been concerned with the effect of paraffins on the nitration of toluene. Basic research on the production of phenols is well under way. Another group is working on the separation of cresols and xylenols from their mixtures. New

derivatives of naphthalene are getting much attention. A detailed investigation, both theoretical and experimental, has been carried out on the conversion of ammonium thiocyanate into thiourea. Studies of the rheological properties of bituminous materials have been continued, and the commercial production and utilization of pitch compounds which exhibit improved flow properties have been supervised. Many of these new products have found industrial application as weather-resistant protective coatings for various metals.

Helpful Research on Natural Gas and Petroleum

Thermodynamic properties of air, liquefaction and storage of natural gas, and thermal insulation are other programs that are going ahead. Research has also been conducted on various ramifications of natural gasoline utilization. Detailed consideration has been given to the economics of production of relatively low-pressure natural gasolines suitable for use as blending agents with various base stocks in the preparation of high quality motor fuels. Because of increasing markets for many of the hydrocarbon components of natural gasoline, investigations have been carried on to determine the identity and quantity of the individual hydrocarbons contained in natural gasolines. Of special wartime interest has been developmental work along the line of producing with air and natural gasoline an industrial fuel having the characteristics of natural gas; the results have proved so successful that several concerns have installed the simple equipment necessary for utilizing this fuel. In crude petroleum correlation research, characteristic portions have been separated, all below 100° C., and a hydrocarbon correlation index of broad scope is in active preparation. Substantial progress has been made in improving fractional distillation techniques under extremely high vacua. An oscilloscope has been devised for determining the dimensions of oil films. The development of special lubricants for fine instruments has been carried along gainfully; entirely new products with superior properties have been created for the Navy. Close cooperation is continually kept up with governmental agencies having to do with liquid fuels, lubricating oils and hydraulic fluids of all kinds.

Scientific Development of Foods

Seven fellowships pertain to major problems of the food industry. Improvements have been brought about in dehydrating prepared foods. The time needed in drying yeast satisfactorily has been shortened. New knowledge has been gleaned in research on decolorizing adsorbents and a new synthetic granular adsorbent has been evolved for the sugar industry. Another fellowship has prepared a dried molasses. A fundamental investigation of the wheat flour lipolytic system is a project in which significant results have been recorded. Carbohydrate preparations for infant feeding have been studied with medical collaboration. The staling of bread is under research of large scope. Certain protein hydrolyzates have been found promising as food-flavoring agents. Aqueous dispersions of bentonite, added to distillery waste, have been shown to be precipitants of the proteins in easily recoverable form.

Solving War Problems in Textile Technology

Several illustrations may be cited from eleven different programs to bring out how textile chemistry is woven into our military fabric. Members of the institute are serving as consultants to the Office of the Quartermaster General in the appraisal of U. S. Army clothing and supplies. Experimental and newly developed items must be subjected to scientifically controlled laboratory and field-use tests; commodity standards and textile specialists from the institute have aided in the planning of these projects and in the analysis of the findings. The weathering of treated fabrics employed as covers over the guns of coastal defenses has been investigated to secure textiles more resistant to sun, salt air, wind and rain. New yarns have been made of soybean protein, alone and with viscose. A synthetic textile lubricant has been composed for the woolen industry. Advances have been gained in the processing of animal fibers used in felt and some physical properties have been correlated with felt quality. Machinery for the production of fresh-water pearl buttons has been improved.

Wood Products and Especially Paper

The piles of wood waste which have been accumulating at wood-working mills producing small protective disks for shells will become a valuable material for making these disks in consequence of studies carried out on the utilization of such waste. Research on lignin degradation products has been advanced. Progress has been realized toward the development of an integrally greaseproof and waterproof carton stock at economic price by elimination of some of the objectionable features associated with such stock in the past. The war's exacting demands for technical paper of many types have necessitated concentrated work on improving strength and durability as well as finding satisfactory substitute raw materials for manufacture. The possibilities for these improvements have been increased by the development of high polymers and other chemicals. GR-S latex has been applied commercially to the saturation of sulfite papers, with

results indicating satisfactory comparability with rubber-latex treated papers but with somewhat less tensile strength.

PATHFINDERS OF PROGRESS IN PLASTICS

The institute's plasticians have maintained their master researchmanship on twenty-four diverse fellowships. Growing attention to cyclopentadiene in the synthetic plastic and organic chemical fields has greatly stimulated research on methods for its utilization. In action is a study of the electrolytic preparation of certain organic compounds of relevance in the manufacture of synthetic resins, rubbers and fibers. A completed two-year investigation has yielded a new curable liner for container closures. Continued research on resin-pulp products has led to further applications for pre-formed materials. The use of new vulcanizable elastomers and low-temperature curing resins has likewise brought advances in the field of cellulosic molding. Organic salts of hydrous aluminum silicates have been studied with reference to their employment as plastics. The development of military and industrial applications of leather-like plastics, announced a year ago, has been extended. Artificial filaments of various types are receiving long-range research. The synthesis of morpholinomethyl derivatives of ureas has been published. New techniques have been introduced for the preparation of vinyl-resin coating compositions; ketones have been described as solvents for those resins.

W. A. HAMOR

(To be concluded)

SPECIAL ARTICLES

THE RELATOINSHIP OF LYSOZYME TO AVIDIN[1,2]

FROM hen's eggwhite two seemingly unrelated biological principles have been obtained, lysozyme and avidin. Lysozyme is a basic protein[3,4] which lyses susceptible microorganisms like *Micrococcus lysodeikticus* or *Sarcina lutea* by depolymerizing and hydrolyzing a mucoid contained in the bacterial membrane[5,6]; while avidin is said to be a basic protein[7] which combines stoichiometrically with biotin, thus depriving the test microorganisms[8] or the animal[9] of this essential vitamin. Some of the reported chemical properties of avidin were so similar to those of lysozyme that we undertook the study of their relationship, although Woolley and Longsworth[7] reported their avidin preparation free of lysozyme activity.

Seven avidin preparations[10] were tested for lysozyme activity against *M. lysodeikticus* and two strains of *S. lutea*. Avidin activity, varying from 60 to 5,200 units per gm, was proportional to lysozyme activity, varying from 4 to 160 units per mg.

The action of biotin[11] on the lytic action of lysozyme was then tested. In these tests acetone dried *M. lysodeikticus* were used, suspended in M/15 KH_2PO_4, corresponding to a density of a No. 10 $BaSO_4$ standard. With live organisms in 0.9 per cent. NaCl the activity is about double. It is known (see review[12]) that the organisms do not dissolve in acid solution, although lysozyme activity is optimal at an acid pH. To demonstrate visible lysis a drop of N NaOH is added at the end of the experiment (usually 1 hour at 37° C.) to stop enzyme activity and to observe clearing of the suspension. The controls without lysozyme are not affected by this treatment.

It can be seen from Table 1 that addition of 10 γ of biotin increases the activity of lysozyme, both against live and acetone-ether killed and extracted organisms, from 8 to 250 times. The effect of 10 γ of biotin is even more marked if incomplete lysis

TABLE 1

Lysozyme preparations	Lysozyme units per mg		*M. lysodeikticus*
	Without biotin	With 10 γ biotin	
Avidin (5200 units/gm)	640	2,600	Living
85 B	2,600	164,000	Living
85 C	1,300	164,000	Living
85 C	640	164,000	Acetone dried
85 C	16	2,000	Acid acetone extracted
85 C	640	164,000	Acetone dried
97 C	1,300	20,500	Acetone dried
97 D	640	5,000	Acetone dried

[1] From the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology, Presbyterian Hospital, New York.

[2] The author is greatly indebted to William L. Laurence for suggesting experiments on the relationship of avidin to lysozyme, and to Miss Anita Steinberg for assistance in this work.

[3] K. Meyer, R. Thompson, J. W. Palmer and D. Khorazo, *Jour. Biol. Chem.*, 113: 303, 1936.

[4] E. P. Abraham, *Biochem. Jour.*, 33: 622, 1939.

[5] K. Meyer, J. W. Palmer, R. Thompson and D. Khorazo, *Jour. Biol. Chem.*, 113: 479, 1936.

[6] L. A. Epstein and E. Chain, *Brit. Jour. Exper. Path.*, 21: 339, 1940.

[7] D. W. Woolley and L. G. Longsworth, *Jour. Biol. Chem.*, 142: 285, 1942.

[8] R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 136: 801, 1940.

[9] P. György, C. S. Rose, R. E. Eakin, E. E. Snell and R. J. Williams, SCIENCE, 93: 477, 1941.

[10] We are indebted to Dr. Vincent du Vigneaud, of Cornell University Medical College, and to Dr. H. M. Wuest, of Hoffmann-La Roche for the samples of avidin.

[11] The generous gift of synthetic crystalline biotin by Dr. D. F. Robertson, of Merck and Co., is gratefully acknowledged.

[12] R. Thompson, *Arch. Path.*, 30: 1096, 1940.

(+++) is taken as the endpoint. The activity then increases, for example, from 20,500 to 10,500,000, that is over 500 times.

In Table 2 the influence of increasing biotin concentration on the lysis of acetone dried *M. lysodeikticus* is shown.

TABLE 2

Biotin concentration in micrograms	Lysozyme units per mg
0	640
0.01	640
0.1	2,600
1.0	5,000
2.0	5,000
4.0	10,000
6.0	41,000
8.0	82,000
10.0	164,000

The data reported here can not be explained with certainty at the present time. In analogy with many other enzyme systems, biotin might be considered as the prosthetic group of a protein carrier. This protein carrier would bind biotin, while the biotin-avidin complex would have lysozyme activity. In accordance with this hypothesis is the fact that avidin contains both free avidin and an avidin-biotin complex.[13]

However, all attempts to dissociate lysozyme into carrier and prosthetic group have failed so far. These attempts included dialysis in acid and alkaline solutions and electrophoresis. The preparation migrated cathodically at pH 7.80 with a sharp boundary ($u = +6.75 \times 10^{-5}$, Dr. D. Moore). It had an activity greater than 1,000 units per mg. The increasing activation of lysozyme with increasing biotin concentration may contraindicate a simple coenzyme effect of biotin, since the concentration of biotin is far greater than that of lysozyme. The biotin effect, however, apparently is not due to action on the test organisms, since it varies in extent with different preparations of lysozyme.

Aside from any hypothesis, however, the experiments reported in this paper definitely link biotin with lysozyme, a mucolytic enzyme concerned with defense against bacterial invasion. It remains to be seen whether a similar relationship holds true for other enzymes of this important group. It might be pointed out further that an enzyme with the bacteriological specificity of eggwhite lysozyme occurs in many if not in all lysozyme susceptible organisms.[5,12] Similar enzymes with other specificities have been demonstrated in many microorganisms. Such enzymes, which in high concentration partly or completely lyse the organisms from which they are derived, are probably concerned with bacterial multiplication.

KARL MEYER

[13] P. György and C. S. Rose, SCIENCE, 94: 261, 1941.

ON THE POSSIBLE IDENTITY OF "AVIDIN"[1] AND EGGWHITE LYSOZYME

COMPARATIVE studies on "avidin"[2,3] and eggwhite lysozyme[4] bring to light a number of common physical and chemical characteristics. Both seem to be present in the same fraction of raw eggwhite in the same relative abundance. Both have been concentrated by similar chemical procedures. The more similar procedures, *i.e.*, those of Meyer *et al.* for eggwhite lysozyme[4] and of Woolley and Longsworth for "avidin,"[3] have also yielded concentrates of qualitatively similar chemical elements, while the quantitative differences could be accounted for by the seeming differences in the degree of purification. Furthermore, the concept of "avidin" as "antibiotin" makes it difficult to reconcile the fact that whereas biotin is found in so many divergent organisms and tissues, "avidin" has hitherto been found only in whites of eggs or in the oviduct of certain species of frogs and fowl.[5] Moreover, the history of biotin, which was found to be identical with coenzyme R and vitamin H, further suggested that "avidin" may also be a more widely distributed substance.

These considerations led to a series of experimental procedures in which (A) a sample of known eggwhite lysozyme, prepared by Dr. Karl Meyer in October, 1937,[6] was subjected to the standard yeast test[7] for "avidin" activity, and (B) samples of "avidin" of known varying potencies,[8] prepared by Hoffmann-La Roche, Inc., were tested for lysozyme activity.[9]

All tests for both (A) and (B) proved strongly positive, and, furthermore, showed that the "avidin" activity in each "avidin" concentrate closely paralleled its lysozyme activity. The results in the (A) series of tests are shown in Table 1.

[1] The term "avidin" as used here refers to concentrates containing both "free avidin" and avidin-biotin complex.

[2] R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 140: 535, 1941.

[3] D. W. Woolley and L. G. Longsworth, *Jour. Biol. Chem.*, 142: 285, 1942.

[4] K. Meyer, R. Thompson, J. W. Palmer and D. Khorazo, SCIENCE, 79: 61, 1934; *Jour. Biol. Chem.*, 113: 303, 1936; *ibid.*, 113: 479, 1936.

[5] R. Hertz and W. H. Sebrell, SCIENCE, 96: 257, 1942.

[6] The author is deeply indebted to Dr. Meyer for supplying him with this sample.

[7] E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

[8] Supplied through the courtesy of Dr. H. M. Wuest, of Hoffmann-La Roche, Inc., and Dr. Ira I. Kaplan, of Bellevue Hospital, New York City. The initial sample tested had a potency of 2,000 units per gm.

[9] The author hereby wishes to acknowledge his debt to Dr. Gustav J. Martin, of the Warner Institute for Therapeutic Research, New York City, for his invaluable assistance in carrying out the experimental work on the "avidin" activity of lysozyme, and to Dr. Meyer, who carried out the tests on the lysozyme activity of "avidin." Dr. Meyer will present his data on these tests, as well as on further tests initiated by himself, in a separate communication.

TABLE 1

"AVIDIN" ACTIVITY OF EGGWHITE LYSOZYME AS COMPARED WITH AN "AVIDIN" CONCENTRATE OF 50 UNITS PER GRAM (S.M.A.)

Tube No.	Biotin (milli-gammas)	S.M.A. Avidin concen. 50 units per g	Lysozyme	Control	Galvanometer reading density
1	50	..	..	√	100
2	50	..	..	√	98
3	50	1 mg	..	..	87.5
4	50	5 mg	..	..	26.00
5	50	..	1 mg	..	56.0
6	50	..	2.5 mg	..	17.5

The data thus show an "avidin" activity of about 100 units per gram for the lysozyme sample. Notice must also be taken of the fact that this sample had been kept for nearly six and a half years at room temperature, which makes it probable that it had lost some of its "avidin" activity, since György *et al.*[10] have observed that whereas the avidin-biotin complex resists the action of digestive enzymes and is also stable to treatment with acid, solutions of "avidin" are slowly destroyed. However, the sample tested had been kept in the form of a dry powder.

The data on the interchangeable activities of "avidin" and lysozyme, along with the data obtained by Meyer[11] strongly suggesting that the lysozyme activity of "avidin" concentrates is due to the avidin-biotin complex, place "avidin" in a new light and promise to provide explanations for certain characteristics that have hitherto appeared paradoxical. Thus, György's observations that "avidin" was "toxic" when given orally, while it was therapeutic when administered parenterally,[12] must now be considered in the light of the present findings, which indicate that "free avidin," rather than being "anti-biotin," more likely serves as a biotin-carrier and thus may be more properly termed a "pro-biotin," its so-called "toxic" effect being due to other reasons, such as molecular size, resulting in its non-absorption from the gastro-intestinal tract.

The data reported here, as well as the data obtained by Meyer, point to the need of a thorough reexamination of the literature on lysozyme from various sources that has appeared since its discovery by Fleming in 1922,[13] and also of the literature of other seemingly related products of bacterial and animal origin, such as the various forms of hyaluronidase and "spreading factor."[14] It may be useful at this time to propose as a working hypothesis that "free avidin" is a member of a group of related substances acting as carriers in a system of enzymes in which biotin serves as the prosthetic group.

[10] P. György, C. S. Rose and R. Tomarelli, *Jour. Biol. Chem.*, 144: 169, 1942.
[11] K. Meyer, Personal communication.
[12] P. György and C. S. Rose, SCIENCE, 94: 261, 1941.
[13] R. Thompson, *Arch. Path.*, 30: 1096, 1940.
[14] K. Meyer, E. Chaffee, G. L. Hobby and M. H. Dawson, *Jour. Exp. Med.*, 73: 309, 1941.

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THE TOXICITY OF ORALLY ADMINISTERED TANNIC ACID

SEVERAL reports,[1, 2, 3] inspired by the use of tannic acid in burn therapy, have recently appeared describing the hepatotoxic effects of tannic acid. Baker and Handler[1] observed striking hepatic necrosis in rats within 48 hours after tannic acid was either painted on an area denuded of skin or injected subcutaneously. It seemed of interest to determine the effects, if any, of orally administered tannic acid.

The diets used and the results are summarized in Table 1. Twelve rats of the Vanderbilt strain were employed in each group. All animals weighed between 50 and 60 grams initially and the experiments were conducted for 90 days.

TABLE 1

Group	Diet	Final weight	Hepatic damage
1	Ground Purina Chow	240	0
2	" " "	180	0
3	" " " +1 per cent. tannic acid	188	0
4	" " " +2 " " "	169	0
5	Synthetic ration[4]	197	0
6	" "	173	0
7	" " +1 " " "	169	0

The animals in group 2 were pair-fed with those in group 3 and those in group 6 with group 7. The deleterious effect of tannic acid on rat growth appeared to be only due to the animal's dislike for the diet. After 90 days the animals were sacrificed by decapitation and liver specimens from each group were taken for histological examination. In no instance was there evidence of the hepatic necrosis described previously. The gastrointestinal tract appears to be completely impermeable to tannic acid since during the course of the experiment the animals in groups 3 and 7 ingested 100 times the amount of tannic acid which, given subcutaneously, invariably produced hepatic necrosis. The innocuous results of tea drinking, by man, are in accord with these findings.

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[1] Roger D. Baker and Philip Handler, *Ann. Surg.*, 118: 417, 1943.
[2] F. W. Hartman and H. L. Romence, *Ann. Surg.*, 118: 402, 1943.
[3] D. B. Wells, H. D. Humphrey and J. J. Coll, *New Eng. Jour. Med.*, 226: 629, 1942.
[4] The synthetic ration was casein 20, cottonseed oil 15, cod liver oil 5, salt mixture 5, sucrose 55. To each kilogram of this diet were added thiamine 2.5 mg, riboflavin 5 mg, pyridoxine 2.5 mg, calcium pantothenate 40 mg, choline chloride 200 mg.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR PREPARING PERMANENT SLIDES OF THE OVA OF PARASITIC WORMS

THE aqueous media commonly used to prepare microscopic slides of ova of parasitic worms give rather fragile preparations which withstand classroom use poorly.[1] Yet these specimens must be mounted in water-soluble materials because dehydration and "clearing" either distort them beyond recognition or render them invisible.

In a limited series of tests of available water-soluble substances that might be used with some hope of improving durability of mounts, one formula of the gum acacia-chloral hydrate medium[2] has given satisfactory results, when used as indicated by the following directions.

(1) Prepare a series of dilutions of gum-chloral in 10 per cent. formalin starting with a 10 per cent. solution and increasing concentrations by 2 per cent. for each subsequent step, or make up each dilution as it is needed.

(2) Concentrate fecal suspensions that have been thoroughly fixed in neutral formalin until each drop of fluid contains 10 to 12 ova. Each cubic centimeter of this will yield about 10 slides.

(3) Pipette 5 cubic centimeters of the concentrated fecal suspensions into vaccine bottles of 15 cubic centimeter capacity. Next add an equal quantity of 10 per cent. gum-chloral-formalin, tilting the bottles to allow this fluid to run in along the lower side. In all dilutions of the series, gum-chloral is heavier than any fecal suspension tested and will occupy the lower half of the column of fluid. Do not shake the bottles or stir the contents.

(4) Cap the bottles and leave them at room temperature or in an incubator at 37° C. until the fecal material has completely settled. Then remove the clear fluid above the feces with a fine-pointed pipette attached to a vacuum pump, and add an equal volume of the next higher concentration of gum-chloral solution.

(5) Continue this process until the ova are suspended in full-strength gum-chloral medium. When the last sedimentation is complete and excess fluid removed, mix the contents of each bottle thoroughly before starting to prepare mounts.

(6) Use clean slides and cover glasses. Circular cover glasses 12 to 15 millimeters in diameter give better mounts than larger sizes. Squares are unsatisfactory for most specimens. Mounts are prepared by two persons working as a team; one transfers drops of the mixture to the slides, the other adds the cover glasses. With some practice one will come to judge the size of drop which will spread completely under the cover glass without excess. For transferring the material to slides, a heavy platinum loop about 4 millimeters diameter is superior to a pipette. The loop delivers a drop of about the correct size with few air bubbles. Cover glasses must be applied quickly to the mounts. Otherwise the medium hardens and spreads poorly.

(7) Dry the mounts in a horizontal position in an incubator at room temperature. Any air bubbles under the cover glass usually are extruded during drying. Thereafter, slides may be treated as if prepared with balsam or clarite. The medium is readily soluble in water, however.

This schedule requires several months for completion, but actually the time given to the specimens is only the matter of minutes for each change of solution. Results amply compensate for the effort. By this method I have prepared mounts of the ova of *Schistosoma mansoni, Clonorchis sinensis, Fasciola hepatica, Diphyllobothrium latum, Hymenolepis nana, Taenia saginata, Ascaris lumbricoides, Trichocephalus trichiurus* and *Enterobius vermicularis*. In these slides small numbers of the ova of some species are distorted, but the majority remain intact and are seen in greater detail than in temporary mounts of formalin-fixed feces. The only failure thus far has been with hookworm eggs, all of which became badly distorted.

Adult *Necator americanus* and other small nematodes, mites, ticks, lice and the larvae and pupae of flies are easily infiltrated and mounted by this method. These organisms remain soft and are easily arranged on slides. When mounted under small round cover glasses, supports do not seem to be necessary.

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